Microhole Smart Steering and Logging-While-Drilling System

DE-FC26-03NT15473

Goal

The overall goal of this project is to provide a modular coiled tubing drilling (CTD) system that allows operators to produce existing U.S. oil reservoirs in a much more effective way than is possible today.

The objectives of this project are to design and build 1) a smart drillbit steering motor integrated with a high-performance downhole motor and 2) a logging-while-drilling (LWD) formation resistivity evaluation sensor that provides real-time information about the rock being drilled. The tools will be designed for deployment in ultra-small diameter wellbores.

Performer

Baker Hughes INTEQ
Houston, TX

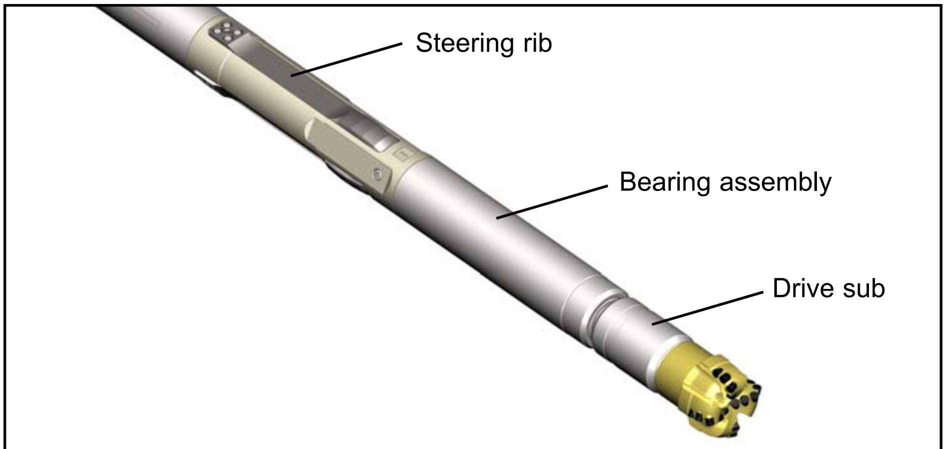
Results

Project accomplishments include the development and evaluation of a number of rib steering motor (RSM) design concepts, and the selection and approval of a final design. This design is now undergoing final manufacture, and assembly of the first of two prototype tools is underway prior to expected field testing in the first quarter of 2006.

Project accomplishments for the magnetic propagation resistivity (MPR) tool include the development of test bench devices and software modeling, which indicate that a resistivity tool employing both 400-KHz and 2-MHz frequencies can be deployed in a 2⅜-inch design. A mechanical design was realized over a couple of iterations, and two prototype tools are currently in manufacturing. It is expected that the tool will meet all project goals.

Benefits

The advanced drilling, steering, and logging bottomhole assembly (BHA) is expected to enable faster drilling, increased well-path accuracy, improved hole quality, and longer horizontal sections. The improvements in drilling and LWD will lead to increased production while decreasing the number of wells.



Schematic of the 2⅜-inch rib steering motor being developed in this project.

Lower costs and reduced environmental risks of drilling smaller holes with smaller-footprint rigs and minimal drilling fluid volumes make the technology ideal for producing remaining oil in shallow, mature U.S. reservoirs. Step-out wells, lateral deep perforations, and well deepening all can improve recovery of domestic resources.

If this technology is developed and deployed, as many as 5,000 new or re-entered wells per year are possible.

Background

State-of-the-art BHAs for CTD of 3½-inch diameter (microhole) horizontal wells tend to drill holes that are not smooth and straight. The lack of straightness leads to higher friction when sliding the coil, which limits the maximum horizontal extension that can be drilled with coiled tubing equipment.

Also absent in the currently available CTD BHAs for microholes is a suitable LWD tool. In order to keep the well within the target zone and above the oil-water contact, resistivity measurements taken during the drilling process are needed to provide instantaneous information about the distance to the water boundary. This allows the well to be drilled for maximum recovery and minimum risk of water invasion. Furthermore, such formation evaluation sensors will be able to detect trapped hydrocarbons along the well path.

Summary

A 2⅜-inch diameter RSM is being designed to serve a 3½-inch or smaller diameter hole. Modules are being designed so they fit seamlessly in the commercially available, modular 2⅜-inch CoilTrak™, a CTD assembly. Hydraulically powered moveable ribs on the steering motor generate steering forces in every direction, allowing both smooth curves and straight borehole sections to be drilled.

An MPR tool is being developed for microholes that will allow true real-time geosteering with instantaneous steering actions based on resistivity (and gamma) measurements.

Current Status (January 2006)

Both components of the project, the RSM prototype and the MPR prototype, have been designed, have passed design reviews, and are currently in manufacturing and assembly. Once assembled, the prototypes will be extensively lab-tested prior to field trails. A special short-radius, 3-inch, bi-center PDC bit has been designed by Hughes Christensen for initial field trials, which are expected to occur March 2006.

Project Start / End: 10-1-04 / 3-31-06
DOE / Performer Cost: $738,667 / $183,417
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